MASSACHUSETTS
TECHNOLOGY
COLLABORATIVE

Renewable Energy Trust

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF TELECOMMUNICATIONS AND ENERGY

Notice of Inquiry on Department of	)	
Telecommunications and Energy	)	D.T.E. 02-38
Distributed Generation	)	

Comments of the
Massachusetts Technology Collaborative
Renewable Energy Trust

August 1, 2002

I. Executive Summary

Introduction

These comments are submitted by the Massachusetts Technology Park Corporation (d/b/a Massachusetts Technology Collaborative ("MTC")), on behalf of the Renewable Energy Trust ("RET") in response to the Department of Telecommunications and Energy's ("Department") June 13, 2002 request for comments with respect to its Notice of Inquiry ("Notice") into distributed generation ("DG"). Specifically, the Department seeks comment on issues related to DG interconnection standards, distribution company ratemaking policies that affect DG owners, the potential role of DG in distribution company resource planning, and on other issues – such as siting, zoning, and environmental impacts – that may be appropriate for consideration as part of the Department's investigation of distributed generation.

The MTC also has a strong interest in the advancement of DG – particularly renewable-based DG – in Massachusetts. MTC administers the Renewable Energy Trust, created by the state legislature as part of the Electric Utility Restructuring Act of 1997 to help the Commonwealth shift toward greater reliance on renewable energy resources to meet its energy needs, and to spur development of the renewable technologies industry as an important source of economic growth in Massachusetts. The RET currently administers programs in three areas – Premium Power/Distributed Generation, Green Buildings and Green Power. Each of these program areas involves significant funding related to investment in DG technologies in the state. All programs include activities related to investment in DG technologies in the state, with the expected outcome of 1100 DG systems to be financed through all MTC programs.

Because Department policies with respect to DG may significantly affect the success of the RET's activities in support of its mission, the RET offers these comments and recommendations regarding actions the Department can and should take to help foster introduction of cost-effective DG[1] by electric distribution companies and end-use customers in electric services territories in Massachusetts. Most importantly, the RET recommends that the Department order the electric distribution companies to participate in a collaborative process with other interested parties to address certain key issues and, if possible, develop consensus proposals for Department regulations and distribution company practices related to DG. The RET believes that a collaborative approach can help the Department quickly identify effective approaches to the complex issues raised in the Notice, and is willing to provide funding and other support, pending approval of the MTC Board of Directors, for such a collaborative process.

Background of the Renewable Energy Trust's Efforts on DG

The RET's comments to the Department in this proceeding draw heavily on the RET's own information-gathering effort related to DG. On May 2, 2002, the RET issued a Request for Information ("RFI")[2] in an effort to understand and explore the challenges and potential benefits of using DG – particularly distributed renewable energy resources – to address issues of transmission constraints and distribution system reliability in Massachusetts. The RET received about two-dozen responses to the RFI in June 2002, including comments from government agencies, distribution utilities, DG vendors, and industry and public interest groups. The RET also held a public meeting on July 22, 2002 to discuss the comments received and obtain additional input. The RET's RFI is attached as Appendix B to these comments, and the RET's summary of the comments provided in response to the RET's RFI is attached as Appendix C.

Summary of MTC/RET Comments on DG Issues

"Distributed generation" comprises a number of different technologies and fuel sources, new and old, including existing and new diesel generators, new gas-fired microturbines, fuel cells, wind turbines and photovoltaics. Many of the benefits and costs of DG are tied to and vary considerably across these technology and fuel types. There are also a number of potential "customers" for the purchase and installation of DG technology, including both end-use customers (and their suppliers of energy and energy services) and distribution (and transmission) companies. The nature and magnitude of DG barriers and benefits will also vary with the purpose of DG installations and whether the customer is an end user or utility.

Finally, it is important to recognize that the potential benefits and costs of DG extend to interests beyond the jurisdiction of the Department. Increased adoption and use of DG may affect electric system dispatch and operations; current costs and future investments in utility transmission systems; the pattern of prices in regional wholesale electricity markets; and, environmental costs or benefits both inside and outside Massachusetts. In this Executive Summary, we briefly

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1 The term "cost-effective DG" may need to be defined differently for DG than other uses in Department regulations.

2 Massachusetts Technology Collaborative, *Request for Information Regarding the Use of Distributed Renewable Energy Generation to Reduce Problems Associated with Transmission and Distribution System Constraints in Massachusetts*, May 2, 2002.

summarize the main benefits, technical issues, and barriers to DG, and present the RET's recommendations in this proceeding. These issues are addressed in greater detail in the main comments, which follow the Executive Summary.

Benefits of DG

DG technologies can improve power supply quality and reliability due to the flexible, dispersed nature of DG installations, the ability to locate these facilities close to electrical load, and the relatively small size of DG applications. Reliability and power quality benefits include both the additional capacity provided by DG, and the location of that capacity in certain constrained locations on the grid. Additional power quality benefits are associated with the ability of some DG technologies to come on line in a relatively short time frame.

These factors have translated into installations with direct and measurable economic benefits to particular customers who can use them (1) as a supplemental power source to maintain a high degree of power quality, (2) as an economic source of emergency backup power, and/or (3) as a dual energy source in combined heat and power ("CHP") mode to capture heat and/or steam for heating or industrial purposes. DG can also indirectly reduce costs for all customers by reducing overall costs associated with the utility's provision of distribution and transmission services.

The advent of location-based marginal pricing in wholesale electricity markets may provide an additional economic stimulus for DG development. In load pockets (such as the Boston/Northeastern Massachusetts zone of the region's electric system) DG could provide stronger economic benefits for the DG customer, and could support a stronger demand response, helping to lower zonal prices for all and mitigate the market power of existing market participants.

Finally, there are a number of potential benefits of DG that do not lend themselves to direct quantification, but whose impact can be significant, including reduced human health and environmental impacts from electricity generation, increased fuel diversity and security and secondary economic benefits. Importantly, the ability to capture these potential benefits depends strongly on the fuels and technologies applied in DG applications.

Technical Issues

While the benefits of expanded DG applications can be significant, a number of technical issues currently hinder wider DG implementation. For example, not all DG technologies conform to power system reliability standards, and an increasing number and broader dispersion of power sources could lead to an increase in the number of "failure points" on the system, adversely affecting power quality. In addition, the intermittent nature and small size of certain DG technologies and applications may complicate market and/or bulk power system interactions or reduce the value of DG in terms of providing energy, reliability and power quality benefits.

Economic, Institutional and Regulatory Barriers

Economic costs borne by end-user customers installing distributed resources impede the expansion of DG applications. At the present time, DG is simply more expensive as a source of commodity electricity available to customers, unless a customer has a special need for power quality or a CHP application. In part, the economic disadvantage to DG is due to the fact that the costs of a DG installation generally must be borne by individual customers, while many of the net benefits flow to the distribution company, other customers, or society as a whole.

Distribution companies also face economic barriers to the installation of DG. In many cases, DG technologies remain more expensive than traditional distribution system equipment and repairs. And, as with customers, distribution companies may experience the problem of split incentives.

Beyond the economics of DG, there stand major institutional and regulatory impediments to the adoption of efficient, reliable and clean DG. A fundamental institutional and regulatory barrier to the expanded adoption of DG is that distribution companies face a financial disincentive to their own or their customers' adoption of DG, due primarily to the design of distribution tariffs that base cost recovery for distribution (and transmission) investment and expenses on the total kilowatt-hour usage of electricity in the company's service territory. At the individual customer level, the design of distribution company tariffs for standby and backup service may unnecessarily add costs for customers who install DG because of how they impose demand charges on load that vary significantly over the relevant time period.

Other institutional barriers to DG include the lack of statewide, common interconnection policies and procedures, the lack of public technical information on the potential locational value of DG to distribution (and transmission) system reliability, and the fact that many customers simply remain unaware of the potential benefits and savings of DG.

A process or planning barrier to distribution companies' adoption of DG exists in addition to the rate structure disincentives. Generally, there is no incentive or requirement for distribution companies to evaluate comprehensively a range of options – including non-traditional options, such as DG – as a solution to distribution (and transmission) system performance and reliability problems. As a result, distribution companies may lack the ability to identify DG as a potential solution, even where it is the least costly option. Another complexity to the adoption of DG is the lingering uncertainty in Massachusetts regarding whether distribution companies can invest in and own distributed generation resources.

Finally, environmental regulatory requirements may pose an additional issue with respect to both customer and distribution company adoption of DG. Massachusetts' non-attainment status under the Clean Air Act requires fairly prescriptive permitting reviews for most new DG above a certain size threshold. While these reviews may be necessary for facilities with relatively high emission rates, the permitting requirements could be made significantly easier for DG technologies with zero or very low emissions rates.

Recommendation for Department Action:
Initiate a Collaborative Process

The foregoing comments highlight the many important and complex technical and policy issues that need to be explored, discussed in greater detail and resolved in order to remove inappropriate barriers to the adoption of DG – and in particular, DG that uses renewable resources – by electric distribution companies and end-use customers. These are significant technical and policy issues on which various parties have important perspectives to share and whose resolution may be accommodated best through face-to-face interactive discussions.

Recognizing this, the RET respectfully recommends that the Department direct Massachusetts electric companies to participate in a collaborative process on these DG issues, with the objective to identify and build consensus on Department actions and distribution company policies. Further, if the Department determines that a collaborative process should proceed, the MTC offers to provide financial assistance – pending approval by the MTC Board of Directors – to pay for facilitation and other services in support of the process. The RET recognizes that its mandate is to promote the use of renewable DG. However, it is not practicable, nor efficient, to address renewable DG and non-renewable DG separately, as non-discriminatory rules need to be established for all DG technologies in the Commonwealth. Thus, MTC stands willing to fund a process that would address all DG technologies with the purpose of maximizing the benefits of this form of energy generation to Massachusetts's customers.

II. Background

A. Mission of the RET and its interest in this proceeding

These comments are submitted by the Massachusetts Technology Park Corporation (d/b/a Massachusetts Technology Collaborative ("MTC")), on behalf of the Renewable Energy Trust ("RET") in response to the Department of Telecommunications and Energy's ("Department") June 13, 2002 request for comments with respect to its Notice of Inquiry into distributed generation ("DG"). Specifically, the Department has identified three issues for this investigation: (1) the development of interconnection standards and practices that do not threaten the reliability or safety of existing distribution systems, but also do not present undue barriers to the installation of distributed generation; (2) the appropriate method for the calculation of standby or back-up rates and other charges associated with the installation of distributed generation; and (3) the appropriate role of distributed generation in distribution company resource planning. In addition, the Department also seeks comment regarding what other issues, such as siting, zoning, and environmental questions, may be appropriate for consideration as part of its investigation of distributed generation.

The Massachusetts Technology Collaborative, a public instrumentality established pursuant to M.G.L. Chapter 40J, is an independent economic development organization whose purpose is to promote sustainable economic growth by supporting regional technology-based clusters and by serving as a public policy laboratory for technology-related initiatives. MTC administers the Renewable Energy Trust ("RET"), created by the state legislature as part of the Electric Utility Restructuring Act of 1997 with the intent and mandate to help the Commonwealth shift toward greater reliance on renewable energy resources to meet its electricity needs, and to spur development of the renewables sector as an important source of economic growth in Massachusetts. MTC seeks to be a catalyzing element for innovation, by supporting research and analysis and facilitating collaboration with public, private and academic leaders and decision-makers to develop a better understanding of, and influence, the economic forces affecting Massachusetts. It is in this vein that MTC recommends that the Department initiate a collaborative process to explore the issues, interests, and potential solutions to the questions regarding distributed generation that the Department has raised in its Notice of Inquiry.

Distributed generation, and in particular distributed generation from renewable energy resources, is core to the mission of the RET, as set forth in the broad environmental and economic goals defined in the Electric Utility Restructuring Act. In particular, the RET's objectives include shifting electric energy consumption in Massachusetts away from conventional energy resources to a greater reliance on energy generated from renewable resources; and increasing electric generating capacity from renewable resources to meet the growing energy demands of consumers in Massachusetts while also encouraging the adoption of energy efficiency measures. Investments undertaken to advance the goals articulated in the Restructuring Act are informed and supported by certain underlying principles, among them that ongoing subsidies for renewable energy should be clearly justified and used only to further the public interest, and that the MTC should collaborate with stakeholders in designing and implementing specific initiatives undertaken through the RET. Guided by the mission articulated in the Restructuring Act and its operating principles, the RET has established a basic strategy for action to promote development of a sustainable market for green power in the Commonwealth and greater use of renewable energy technologies in distributed generation in the Commonwealth.

The outcome of regulatory actions affecting distributed generation in the Commonwealth is of deep interest to the MTC, as it seeks to achieve the mission of the RET. The RET has exerted significant effort will continue to do so as it seeks to shift the Commonwealth toward greater reliance on renewable energy resources and to spur the development of the renewables sector as a source of economic growth in Massachusetts.

B. Background of the RET's Efforts Regarding Distributed Generation

Resolution of issues presented in this Inquiry will contribute to the success of the RET in meeting its mission as set forth by the Massachusetts Legislature. The RET currently pursues its mission through three major programmatic areas: Premium Power/Distributed Generation, Green Buildings and Green Power. The RET's programs provide support through grants, research and analysis to increase supply of and demand for renewable energy resources in the Commonwealth, including by siting and installing distributed resources. All programs include activities related to investment in DG technologies in the state, with the expected outcome of 1100 DG systems to be financed through all MTC programs. This section summarizes the RET's programmatic activities with respect to DG, while a more detailed description of the programs is attached as Appendix A to the comments.

The principal aim of the Premium Power/Distributed Generation Program is to promote the use of distributed renewable energy generation technologies in Massachusetts. The initial focus of this $16 million program is to install distributed resources in applications that require high reliability and/or power quality, such as is provided by fuel cell-based or "premium power" systems. Programmatic activities have included issuance of two formal solicitations to explore and promote the use of fuel cells to provide highly reliable power. The first solicitation provides funding to examine the feasibility of using fuel cells in premium power applications. The second solicitation makes funds available to help organizations defray the cost of installing fuel cells in stationary, high quality power systems. For example, MTC has assisted Nuvera Fuel Cells, Inc. in testing advanced fuel cell power systems to provide high quality power at one of Verizon's metro-Boston telecommunications network hub.

The Premium Power/Distributed Generation Program has also been very active in the analysis of the regulatory and business practice impediments facing distributed generation in the Commonwealth. The most notable of these efforts is the recent issuance of a Request for Information (RFI) to understand and explore the challenges and potential benefits of using DG – particularly distributed renewable energy resources – to address issues of transmission constraints and distribution system reliability in Massachusetts. Details of the RFI and its significance to the Department's Notice of Inquiry on DG are provided in the following section.

While the Green Buildings Program is not focused on distributed generation, it includes a significant renewable DG component. The Green Buildings Program has allocated approximately $30 million in the form of grants to support about 50 "green" buildings in Massachusetts, which could easily exceed 5 megawatts of DG capacity. The goal of the Green Buildings program is to stimulate the increased construction of green buildings in general, and the use of renewable energy technologies in particular to increase knowledge about the benefits of green buildings and renewable energy technology among building professionals and the general public. To qualify for assistance, a building must include a renewable energy source such as photovoltaics, wind turbines, and fuel cells. As a result, the Green Buildings Program will be affected by this Inquiry and the Department's policy toward DG that may result.

Lastly, the Green Power Program addresses the addition of power from renewable energy resources such as wind, biomass, landfill gas and photovoltaic (PV) technology to the New England distribution grid. Again, while distributed generation per se is not its focus, financial and other assistance for distributed resources are a significant component of the Green Power program, as most clearly evidenced through its $10 million commitment and activities in the Solar to Market Initiative to install PV systems throughout the Commonwealth.

As indicated above, the RET has been extremely active in a variety of areas that will be affected by the outcome of the Department's investigation into DG and any subsequent policies that may result. Issues such as those articulated by the Department – consistent interconnection standards, the design of standby and backup service, and the role of DG in distribution company planning – may impinge on RET's effectiveness in maximizing the benefits of renewable energy to the citizens of Massachusetts in the years ahead.

C. Description of Renewable Energ Trust's Recent Information Gathering on DG

On May 2, 2002, the RET issued a Request for Information ("RFI") in an effort to understand and explore the challenges and potential benefits of using DG – particularly distributed renewable energy resources – to address issues of transmission constraints and distribution system reliability in Massachusetts. The RET received about two-dozen responses to the RFI in June 2002, including comments from government agencies, distribution utilities, DG vendors, and industry and public interest groups. The RET also held a public meeting on July 22, 2002 to discuss further the potential role and impact of renewable DG on electricity system constraints in Massachusetts and the impact of renewable distributed generation on the existing problem. The RET's RFI is attached as Appendix B to these comments, and the RET's summary of the comments provided in response to the RET's RFI is attached as Appendix C.

The comments received by the RET in written form and at the public meeting have informed the RET on various issues relating to DG benefits, barriers and opportunities. The RET's comments in this Notice of Inquiry (D.T.E. 02-38) draw heavily on what was learned through the RFI process.

D. Organization of the Renewable Energy Trust's Comments

In Section III of these comments, we describe (1) the context for DG resources in Massachusetts; (2) the reliability, economic and other benefits that result from DG installation; (3) various technical issues associated with DG expansion on the grid, and (4) important economic, institutional, and regulatory barriers to increased adoption of DG. In Section IV, we make recommendations regarding actions the Department can and should take to help foster the introduction of cost-effective DG by electric distribution companies and end-use customers in electric services territories in Massachusetts. Chief among these is the RET's recommendation that the Department order the electric distribution companies to participate in a collaborative process with other interested parties to attempt to resolve certain key issues and, if possible, develop consensus proposals for Department regulations and distribution company practices relative to DG. The RET stands ready to provide funding and other support, pending approval of the MTC Board of Directors, for the collaborative in order to move the process along expeditiously. Finally, Section V summarizes our conclusions.

III. Benefits and Barriers

In this section, we summarize for the Department why we believe it should use this proceeding to establish non-discriminatory rules and other policies that open the door for and encourage the expanded installation of cost-effective DG in the service territories of Massachusetts utilities. First, we identify some preliminary issues important to set the context for Department actions related to DG. Next, we identify the public policy rationale for Department action by summarizing the reliability, economic, and other benefits that can result from DG installations. Finally, we identify the reasons why Department action is necessary to obtain these benefits, by reviewing technical issues associated with DG expansion on the grid, and by discussing the primary economic, regulatory, and institutional barriers to growth in DG adoption and use in Massachusetts.

A. The Context for Distributed Generation

It is important at the outset to be explicit about the technologies, transactions, and jurisdictional entities related to or affected by DG issues important to the Department's proceeding. In response to its RFI, the RET received written and oral comments from a wide range of electric industry participants, utilities, customers, and government agencies. The RFI requested broad-level, general information on technical and regulatory issues associated with DG, and in particular with regard to its usefulness in resolving congestion on transmission and distribution systems when DG resources are implemented either by electric companies or their customers. In contrast, the Department's inquiry necessarily involves a more narrow focus consistent with the agency's jurisdictional boundaries and public interest obligations.

It can be difficult to speak in general terms about DG economics and system and environmental impacts. This is because what is typically referred to as "distributed generation" actually comprises a number of different technologies and fuel sources, new and old, including existing diesel generators, new gas-fired microturbines, fuel cells, wind turbines, and photovoltaics. Many of the benefits and costs of DG are tied to particular DG technologies and the fuel used in different DG systems, and the benefits and costs vary considerably across these fuel and technology types. Consequently, the potential system benefits, interconnection hurdles, and regulatory barriers will vary across different DG technology options that may be identical in other ways (e.g., size, location). The effort to reduce unnecessary barriers to growth in DG requires recognizing the distinctions among specific DG technologies, and ensuring consistent and fair treatment of all potential options. In addition, an analysis of DG benefits, cost, and barriers should acknowledge that impacts are vastly different with high DG penetration versus low DG penetration.

The scale and modular nature of DG means that there are also a number of potential "customers" for the purchase and installation of DG technology. For example, DG most often has been installed by large end-use customers with special requirements for power service, such as the need for emergency backup service or a higher degree of power quality than can be supplied through grid interconnection only. DG can also be installed by distribution (or transmission) companies as an alternative to line extensions and/or other distribution equipment, to provide peaking capacity, or to delay or avoid upgrades to local transmission or distribution infrastructure. The nature and type of DG barriers and benefits will vary with the purpose of DG installations and whether the customer is an end user or utility.

Finally, an important distinction from the standpoint of the Department is that installation of DG may involve a distribution of responsibilities for and costs or benefits of DG among various entities and interests, including those not subject to the ratemaking and oversight jurisdiction of the Department. That is, due to its statutory responsibilities, the Department's interest in evaluating DG policies and regulations will depend primarily on the impact of DG on the regulated distribution companies and their customers, but should also consider the secondary economic and other benefits and costs that accrue to the businesses and residents of Massachusetts.

However, the impacts of DG are not limited to these interests. For example, in certain circumstances, increased DG adoption and use can (a) impact electric system dispatch and operations (involving the ISO New England Inc.), which is subject to federal jurisdiction, rather than the distribution company, which is subject to the Department's regulation), (b) affect current costs and future investments in utility transmission systems (involving transmission companies wholly or partly subject to federal jurisdiction), (c) alter the pattern of prices in the regional electricity markets (affecting wholesale market participants), and (d) lead to environmental costs or benefits both inside and outside Massachusetts (affecting residents of other states in addition to those located here). It will be important to keep these distinctions in mind when reviewing the impacts of DG in the Commonwealth, the policy issues affecting DG, and the steps the Department can and should take to encourage cost-effective adoption and use of DG in Massachusetts.

In these comments, the RET will keep these distinctions in mind. In particular, while there are important issues outside the specific jurisdiction of the Department that need to be understood and considered, our comments will focus on how the Department can help support the expansion of DG in a manner that is consistent with its ratemaking, general oversight, and public interest authorities, and that recognizes the potential economic and environmental costs and benefits to Massachusetts.

B. The Benefits of Distributed Generation

DG has been used for years by customers to help them maintain electrical service in times of system interruptions, and to maintain a high degree of power supply quality. Below we summarize the expected benefits of DG including ongoing applications to improve power system reliability and power quality, economic benefits associated with potential reductions in costs to customers and utilities, and additional potential benefits to power systems, competitive markets, the environment, and the local economy.

1. Reliability and Power Quality Benefits

DG technologies can improve power supply quality and power system reliability due to the flexible, dispersed nature of DG installations, the ability to locate these facilities close to electrical load, and the relatively small size of DG applications. Additional power quality benefits are associated with the ability of some DG technologies to come on line in a relatively short time frame.

In the most fundamental sense, the addition of DG resources improves reliability by adding resources for capacity, reserves, and ancillary services to the electricity generation and delivery infrastructure within the state. The existence of additional DG capacity in certain locations on the grid provides this benefit despite the fact that system support is not always the intended purpose of these resources (since many DG installations are put in place with the intention of providing only emergency power support to the customer on whose site the DG is installed), and DG costs may generally be uneconomic in comparison with most generating capacity in the region.

Beyond the simple provision of additional generation capacity to an end-use customer, DG can be used to provide local transmission and/or distribution system support. If located strategically, DG can reduce local line loading, assisting in local voltage stabilization and improving circuit reliability. If well designed, DG can also help address power factor concerns. These potential benefits at the local level are particularly important in areas where it may be politically or technically difficult to address system support issues through the siting of additional large-scale generation or transmission infrastructure. In this sense, the small size and mobility of DG resources can provide localized and appropriately scaled responses to distribution system reliability and power quality issues and can do so in a timely fashion.

Finally, DG can be viewed as a resource in the context of system outages or disruptions. In addition to being available for operation in the event of sudden system contingencies, it may be possible to use dispersed DG resources to help with system restoration in the event of wide scale outages.

2. Economic Benefits

Presumably, the primary driver for expanded adoption and use of DG in the near future will be the same as it has been historically: namely, the existence of a strong economic incentive for installation by end users. Historically, most DG applications have occurred where there are direct and measurable economic benefits to particular customers who then proceed to install them on their premises. For example, DG can be effective as a supplemental power source to maintain a high degree of power quality in industries that rely on machinery that is very sensitive to even minor power supply disturbances (e.g., voltage sag). DG can also be an economic source of emergency backup power for commercial or industrial operations where short- or long-term power outages can lead to substantial losses in output or productivity. Typically, backup and emergency DG applications are used to protect against economic losses that greatly exceed the additional costs to companies of DG installations.

From the perspective of a customer, the existence of a need for heat and/or steam for heating or industrial processes can vastly improve the economics of installing DG for continuous operation (as opposed to periodic emergency or backup operations) in combined heat and power ("CHP") mode. The existence of CHP potential has been a primary economic factor supporting the installation of DG applications in industrial, hospital and university campus applications.

While an individual customer's desire to reduce its energy bills and/or provide power supply in the event of an emergency or power quality problems has been the driving force behind existing DG installations, the existence of a competitive market and (in the future) location-based marginal pricing ("LBMP") could provide an additional stimulus for DG development. Specifically, these market features may provide additional economic benefits through self-generation in hours when the price of electricity is high (and, in the world of LBMP, where the price is high). Of course, taking advantage of these additional economic benefits requires that customers have advanced metering, access to real-time pricing information, and an electricity supply arrangement with an appropriate pricing structure.

Widespread use of DG in customer applications could also provide price benefits for other customers. For example, in a robust market the widespread application of price-responsive DG can in effect reduce aggregate load in high-price periods, creating a downward pressure on wholesale market prices. To the extent that short-term market prices influence longer-term pricing arrangements, the market influence of DG can lower the price paid by all consumers for electricity. Importantly, this influence on customer electricity costs would be greatest in heavily congested zones (such as the Boston/Northeastern Massachusetts areas of New England's grid), since the greater magnitude and duration of high electricity prices provides a stronger economic impetus for the installation of DG (and other demand response) applications. In these load pockets, a stronger demand response will also help to mitigate the market power of existing market participants.

DG can also indirectly reduce costs for customers by reducing overall costs associated with the utility's provision of distribution and transmission services. As noted in the previous section, installation of DG can improve power quality and reliability due to the flexible, dispersed nature of DG installations and the ability to locate DG facilities close to load. Consequently, to the extent that more widespread installation of DG occurs within a utility's service territory, the utility may be able to at least defer and possibly avoid altogether the need for additional investments in distribution and/or transmission system maintenance, repair and infrastructure, reducing regulated rates for all customers.

3. Additional Benefits (and Potential Costs)

In the preceding section, we discussed a number of direct economic benefits that may flow to end users, other customers, and utilities associated with increased utilization of DG. There are a number of other potential benefits of DG that do not lend themselves to direct quantification, but whose impact can be significant, including reduced human health and environmental impacts from electricity generation, increased fuel diversity and security, and secondary economic benefits. We say potential because the environmental and fuel diversity benefits are strongly dependent on the fuel and technology used in emerging DG applications. Since the least expensive DG technologies currently available also happen to be among the worst from environmental and fuel diversity perspectives, growth in DG could lead to significant environmental and diversity costs.

The potential environmental impacts associated with a particular DG installation depend on the emissions and waste profiles of the installed technology compared against the emissions and waste profiles of the generation that would be dispatched absent operation of the DG application. Typically, emission rates associated with the marginal generation in New England at the higher end of the load curve – the time when DG operation is most economic and highly valued – include a significant contribution from fossil-fuel generating facilities with relatively high emission rates, characteristically older plants or plants used as peaking facilities. Certain DG technologies (such as renewable DG) have emission rates much lower than these marginal emission rates, but other DG technologies (such as diesel DG) have emission rates much higher than system-wide marginal emission rates.

The potential impact of DG operations on public health is amplified by several factors. First, DG applications are greatest and most economic in urban locations where commercial and industrial operations and high population density provide fertile ground for capitalizing on the additional benefits associated with CHP applications. Second, the relatively small size of DG applications means that stack height requirements are low enough that a large portion of facility emissions will reach ground level close by, maximizing public exposure given the population density of urban locations. Third, the hours of high load when DG is most economic frequently occur in hot summertime conditions already associated with high concentrations of harmful pollutants (such as ozone and particulates).

In these circumstances, the installation and operation of DG could result in either significant costs or benefits related to public health and environmental impacts, depending on the predominant DG technology installed. Moreover, the small size and relatively high unit costs of emission controls for fossil-fuel based DG facilities have complicated the task of fully addressing their impacts through existing environmental regulations. Since these costs or benefits are for the most part excluded from any customer or utility evaluations of project economics, care should be taken in the evaluation of DG environmental impacts.

DG can provide system security benefits by increasing the number and geographic dispersion, and decreasing the average size of generation resources in the region. To the extent that emerging DG applications rely on renewable technologies, DG can also provide fuel diversity benefits for the region. To the extent that increased DG reduces dependence on oil-fired generation, it will reduce dependence on foreign fuels.

Finally, expanding DG in Massachusetts will almost certainly lead to the development or expansion of local business opportunities to design, build, maintain and repair DG installations. This is an example of how DG can lead to secondary economic benefits that are not typically included in traditional project benefit-cost evaluations.

C. Technical Issues

While the benefits of expanded DG applications can be significant, a number of technical issues, among other things, currently hinder wider DG implementation. These technical issues must be resolved before the benefits of DG can be realized. The responsibility for resolving these technical issues varies, with some the responsibility of the Department (e.g., relating to Department regulation of electric distribution companies), some the responsibility of distribution companies directly (e.g., related to interconnection policies and procedures), and some the responsibility of the DG industry (e.g., technical performance standards).

The technical issues affecting the deployment of DG fall into two categories. The first set of issues generally relates to the "engineering" of DG and its integration into the distribution system. The second set of issues relates to the interaction of expanded DG applications with the operation of the bulk power system and wholesale electricity market.

1. Integration with the Distribution System

A threshold issue for the integration of DG into the distribution system is the need for DG technologies to conform to distribution system reliability requirements. The successful deployment of DG in Massachusetts will require that reliability performance standards be established and met by the DG industry. To the extent that reliability standards for DG do not yet exist and/or are not yet generally accepted, the DG industry needs to work with distribution companies (and the bulk power system operator) to develop one or more that both ensure reliability and allow for the appropriate deployment of DG in a manner that enhances system reliability and flexibility.

While appropriately sited DG can provide benefits in terms of improved system reliability, an increasing number and broader dispersion of power sources may lead to an increase in the number of "failure points" on the electricity system. Success in expanding the deployment of DG can enhance the reliability, flexibility and robustness of the distribution system, but it may also introduce another component of the system whose performance must be installed and monitored in such a manner to ensure that its possible failure will not have an adverse impact on the distribution system.

For example, one of the benefits of DG is that it can help to improve power quality for customers. However, a larger number of DG installations in a local area may require more active regulation of voltage and reactive power by the distribution company to avoid potential negative power quality impacts for those same or other customers. On the customer side, installation of some DG technologies (e.g., fuel cells) may require accompanying use of other technologies, such as energy storage, to achieve reliability and power quality benefits and to avoid potential negative impacts, such as result from increased harmonics.

2. Interactions with the Wholesale Market and Bulk Power System

In addition to technical issues that may arise with the integration of DG into the distribution system, there may be features of certain DG technologies that complicate market and/or bulk power system interactions or reduce the value of DG in terms of providing energy, reliability and power quality benefits. For example, the intermittent nature of some DG technologies (e.g., solar and wind) makes them non-dispatchable from a bulk power system point of view and thus may limit their value for system reliability and security. To provide such benefits, these technologies may need to be accompanied by energy storage or other applications. These accompanying technologies may be useful not only to address technical problems affecting power quality to the customer installing the DG, as described above, but also valuable to the system operator in that they enable the DG to provide additional benefits to the system.

The small size of many DG applications may also complicate or limit real-time interactions with system operator. Part of the solution for the system operator may be the installation of advanced metering. Such metering would also provide value to the customer with the DG installation by enabling it to take advantage of market price fluctuations.

3. Technical Solutions

We have distinguished these technical issues and characterized them as such to differentiate them from the economic, institutional and regulatory barriers described in the following sections. By and large, the technical challenges presented by the expanded application of DG technologies can generally be resolved with technical fixes up to any level of deployment reasonably likely to be achieved. The question becomes one of the costs of these remedies and the effect of these costs on the economics of broader deployment of DG.

D. Economic Barriers

Economic costs borne by end-use customers installing distributed resources impede the expansion of DG applications. Several factors affect the economics of DG for customers. Currently, electricity generated from distributed resources is simply more expensive than the cost of grid-supplied commodity electricity available to customers. Unless a customer has a special need that cannot be met without the installation of on-site generation or a separate thermal demand that would make a CHP application attractive – both of which require investment in additional system configurations and processes – DG stands at an economic disadvantage.

In part, the economic disadvantage to DG is due to the fact that the costs of a DG installation generally must be borne by individual customers, while many of the net benefits flow to others (e.g., the distribution company, other customers, society) in the form of increased reliability or, with certain technologies, improved environmental impacts. The problem of split incentives is not unique to DG and the need to provide for remedies or resolutions has been recognized with respect to other potential resources in the electric industry (e.g., energy efficiency).

Customers faced with the question of investing in DG also encounter financing difficulties. These customers are often reluctant to invest in or pursue financing for something like DG that is not part of their core business activity. In addition, there are financing impediments to DG which often costs more than can be covered out of pocket but less than can be project financed.

Distribution companies also face economic barriers to the installation of DG. In many cases, DG technologies continue to be more expensive than traditional equipment for upgrading and maintaining the distribution system. As with customers, there may be an issue of split incentives where the costs of the DG are borne by the distribution company making the investment while the benefits accrue more broadly. Finally and perhaps more importantly, as discussed in the next section, institutional and regulatory barriers make the installation of DG financially unattractive for distribution companies under the current framework.

E. Institutional and Regulatory Barriers

While the economics of many DG installations are such that they present a barrier to expanded application, this situation can be expected to change as costs for DG technologies come down over time and as DG may be increasingly deployed in conjunction with other technologies, such as CHP. Beyond the economics, however, there stand major institutional and regulatory impediments to the adoption of efficient, reliable and clean DG.

1. Overall Adoption of DG

A fundamental institutional and regulatory barrier to the expanded adoption of DG is that distribution companies are not financially indifferent with regard to their own or their customers' adoption of DG due to the design of distribution tariffs that base cost recovery for distribution (and transmission) investment and expenses on kilowatt-hour usage of electricity. Moreover, other customers may not be financially indifferent either.

In fact, distribution companies face an actual disincentive to the expanded application of DG technologies under the current tariff system. Every kilowatthour generated by DG is one less kilowatthour sold by the distribution company. In the short term, lower sales levels reduce revenues to the distribution company. Over the longer term, following a rate case, such lower sales volumes may lead to higher distribution rates as costs must be spread over a smaller total number of kilowatthours sold.

Higher rates may present a disincentive not only to the distribution company but to other customers as well, who may perceive a shifting of costs from customers who have installed DG to those who have not. (Where the distribution company has installed the DG, any increase in rates due to allocating costs over fewer kilowatthours would presumably be offset by lower distribution costs overall that warranted the DG investment in the first place.) A major challenge will be overcoming this fundamental institutional and regulatory barrier to the expanded deployment of DG.

2. Customers' Adoption of DG

At the individual customer level, a number of other institutional/regulatory barriers present themselves. The design of distribution company tariffs for standby and backup service may unnecessarily add costs for customers who install DG because of how such tariffs impose demand charges on loads that vary significantly over a day, month or other relevant time period. Again, the distribution company understandably wants to be assured that it will recover any costs it incurs to provide standby or backup service to DG customers and other non-DG customers want to be sure that any costs incurred are not shifted to them. The challenge will be to design standby and backup rates that fairly accomplish all of these goals.

Another institutional barrier to the expanded application of DG technologies is the lack of statewide, common interconnection policies and procedures for DG, which raises the costs of adopting DG for the customer as well as for the distribution company. Work is under way on the development of a national standard for DG interconnection, but its value would be enhanced with the development of common state, if not regional, level procedures for interconnection.

Customers' adoption of DG is also hindered by the lack of public technical information on the distribution (and transmission) system that would help prospective DG developers take advantage of higher-value locations for DG, especially under LBMP. Currently, customers do not see accurate electricity price signals. This situation may be remedied at the wholesale level with the advent of LBMP; however, further action at the retail level will be needed to ensure that accurate price signals reach the end-use customers making the decision whether to install DG.

Finally, many customers simply remain unaware of the potential benefits and savings of DG.

3. Distribution Companies' Adoption of DG

A process or planning barrier to distribution companies' adoption of DG exists in addition to the rate structure disincentives. Many distribution companies may have a process for identifying the need for distribution infrastructure upgrades and determining what they believe is the appropriate investment to address those needs. Generally, however, there is no incentive or requirement for distribution companies to evaluate comprehensively a range of options – including non-traditional options, such as DG – as a solution to distribution (and transmission) system performance and reliability problems. As a result, distribution companies may lack the ability to identify DG as a potential answer to a distribution system need, even where it is the least costly option. Without an open and transparent distribution system planning process, distribution companies are especially likely to miss DG options to address distribution system needs that may be available on customer premises. Just as the availability of information on distribution (and transmission) system needs is important for facilitating customer investment in DG, it is equally if not more important for ensuring that the distribution company itself is aware of all of its potential options.

Another potential barrier to distribution companies' adoption of DG is the lingering uncertainty in Massachusetts regarding investment and ownership of DG. There are questions as to whether regulated distribution companies may be able to own or invest in DG. Such ambiguities, including lack of clarity among stakeholders regarding how DG is defined (generation versus distribution), will need to be addressed to advance DG installations in the Commonwealth. If limitations on utility ownership of DG exist, other options – such as leasing – should be explored to ensure that distribution companies are able to realize the full potential of DG technologies for meeting distribution system needs.

4. Additional Issue Regarding Overall Adoption of DG

Environmental regulatory requirements pose an additional issue with respect to both customer and distribution company adoption of DG. Massachusetts' non-attainment status under the Clean Air Act requires fairly prescriptive permitting reviews for most new DG. These permitting requirements could be made significantly easier, particularly for DG technologies with zero or very low emissions rates. For instance, we are aware that the Regulatory Assistance Project, a non-profit organization that working with electric power policy makers to identify and implement workable policies that foster energy efficiency and renewable resources, recently convened a working group of state utility regulators, air pollution regulators, industry representatives, and environmental interests to consider the impact of DG permitting requirements, and develop model emission standards for these technologies. The Massachusetts Department of Environmental Protection (DEP) has participated in this collaborative and may choose to use the model rule to propose standards that would apply in this state. Consequently, we encourage the Department to pay close attention to this effort, and hope that DEP would participate in this proceeding and other collaborative efforts that may be follow to consider these issues.

IV. Comments on Questions in the Department Notice

A. Overview

The foregoing comments highlight the many important and complex technical and policy issues that need to be explored, discussed in greater detail and resolved in order to remove inappropriate barriers to the adoption of DG – and in particular, DG that uses renewable resources – by electric distribution companies and end-use customers. These are significant technical and policy issues on which various parties have important perspectives to share and whose resolution may be accommodated best through face-to-face interactive discussions.

Recognizing this, the RET respectfully suggests that the Department direct Massachusetts electric companies to participate in a collaborative process on these DG issues, with the objective of the collaborative process to identify and build consensus on certain actions the Department can take to ensure that DG has non-discriminatory access to the distribution system. Further, if the Department determines that a collaborative should proceed, MTC offers to provide financial assistance, pending approval by the MTC Board of Directors, to pay for facilitation and other services in support of this collaborative process.

The RET's proposals for the process and its offer of support for it are described further below.

B. The Proposed DG Collaborative Process

In light of the many important technical and policy issues that need to be resolved to assure DG non-discriminatory access to the distribution (and transmission)system, the RET recommends that the Department order the state's electric distribution companies to participate in a collaborative process with other interested parties to attempt to resolve certain key issues relating to DG implementation. The purpose of the collaborative process would be to discuss and if possible develop consensus proposals for Department regulations and distribution company practices that support non-discriminatory access to the grid for DG.

There are many important issues that the Department should ask the parties to explore in the collaborative process and for which the parties should attempt to make recommendations. These issues include the tariff issues, interconnection issues, and distribution planning issues the Department identified in its June 13, 2002 request for comments on DG. Additionally, the issues include industry standards and environmental permitting issues.

Specifically, the RET recommends that if the Department orders a collaborative process, the following items should be addressed, as well as any other issues the Department deems necessary:

- Identify and discuss the impacts of any disincentives that exist generally for distribution companies with regard to adoption of DG by the utility or by its customers, and recommend any possible modifications that remove these disincentives, while also assuring electric companies appropriate cost recovery and avoiding inappropriate cost-shifting among customers;

- Explore any ways in which standby service tariffs, in particular, act as a barrier to DG, and if so how to remedy this problem through establishment of generic cost-based principles and/or model tariffs for standby and backup service that can then be adopted or applied on a company-by-company basis;
- Examine Massachusetts electric companies' interconnection policies from the point of view of whether they afford DG non-discriminatory access to the distribution (and transmission) system, and if not, what remedies are appropriate to assure that access without compromising the provision of reliable distribution service to all customers;
- Discuss the role(s) of, and specific actions for, the Department, the electric companies and others in supporting the adoption of (1) uniform interconnection standards, possibly modeled on the uniform standards of IEEE or some other state; (2) common state interconnection policies and procedures; and (3) industry-wide technical reliability standards for DG by the appropriate industry group;
- Explore, and where appropriate make recommendations regarding, distribution company planning practices and processes and Department requirements that affect them, from the perspective of ensuring that these processes consider, and where appropriate adopt, DG to meet any reliability and other utility objectives;
- Examine what types of information and other resources should be made available to the public by electric companies regarding the location of constraints on the distribution system, including: information on locations where distribution (and transmission) systems require reinforcements, upgrades, etc.; ways to provide price signals that convey information to consumers about the value of distribution reinforcements, upgrades, etc.; and ways to compensate consumers for their investments in DG that provide reliability value to the system; and
- Identify and discuss issues relating to the environmental impacts of different DG technologies, and what role(s) the Department should play with respect to the DEP in assuring that reliable and cost-effective DG technologies that provide additional public health, environmental and fuel diversity benefits have an opportunity to be sited and operated.

Further, the RET recognizes that its mandate is to promote the use of renewable DG. However, from a process standpoint, it is more appropriate to address renewable DG and non-renewable DG together, as the Department rules may have impacts across all DG technologies and applications. Thus, MTC stands willing to fund a process that would address all DG technologies and the full scope of issues in this proceeding.

C. Proposed Draft Department Order to Establish the DG Collaborative Process

In order to move the process forward as expeditiously as possible, the RET recommends that the Department issue an interim order in the instant proceeding, D.T.E. 02-38, as soon as possible, and ideally no later than four weeks, following receipt of party submissions in response to the Request for Comments. The RET respectfully suggests that the process and schedule for the collaborative require that the collaborative begin within four weeks of issuance of the Department’s order establishing it. The RET further suggests that the Department establish a progress schedule, including filing of status reports, and filing a final report at the conclusion of the collaborative process. The RET is committed to seeking ways to enable the most widespread participation without causing burdensome time requirements for any individual participants.

D. Proposed MTC Support for the DG Collaborative Process

In order to support an efficient and effective collaborative process on distributed generation, MTC, through the Renewable Energy Trust, offers to provide funding and other means of support. Specifically, MTC offers to: (a) provide financial support and facilitation services for the collaborative process itself with guarantees of independence for providers of such services; (b) sponsor relevant research and analysis on issues raised during the collaborative process (e.g., best practices in other states); (c) participate as a party in the collaborative discussions, especially in support of assuring non-discriminatory access for renewables DG; and (d) consider any other recommendations which the Department deems necessary to adequately complete this process.

The RET welcomes the assistance of other parties in supporting this collaborative process, and by no means is this offer to fund a collaborative intended to preclude other parties from participating in the support for the process. However, if other entities are not in a position to contribute financially to such an effort, MTC is prepared, pending approval by the MTC Board of Directors, to support reasonable out-of-pocket costs of the facilitated collaborative process.

V. Conclusion

In these comments, the Renewable Energy Trust has described a set of significant, technical and policy issues affecting the cost-effective adoption and use of DG resources by electric utility companies and electricity consumers in Massachusetts. In light of the many important technical and policy issues that need to be resolved to assure DG non-discriminatory access to the distribution system, the Trust believes that it would be appropriate for the Department to order the state's investor-owned electric distribution companies to participate in a collaborative process to work with other interested parties to attempt to resolve certain key issues relating to DG implementation. The purpose of the collaborative process would be to discuss and if possible develop proposals for the Department's regulations and distribution company practices that support non-discriminatory access of DG to the grid.

The Massachusetts Technology Collaborative offers to support the establishment and workings of such a collaborative process through: (a) provision of financial support for facilitation of the collaborative process, pending approval of the MTC Board of Directors; (b) sponsoring relevant research and analysis on issues raised during the collaborative process (e.g., best practices in other states); and (c) participation as a party in the collaborative discussions, especially in support of assuring non-discriminatory access for renewables DG.

submitted by
Robert L. Pratt, Director, Renewable Energy Trust
on behalf of the
Massachusetts Technology Collaborative
Renewable Energy Trust
75 North Drive
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dated: August 1, 2002

Appendices attached

APPENDIX A

Massachusetts Technology Collaborative
Renewable Energy Trust

Programmatic Activities of the
Renewable Energy Trust

APPENDIX A

Massachusetts Technology Collaborative
Renewable Energy Trust

Program Descriptions

The Massachusetts Technology Collaborative ("MTC") is an independent economic development organization whose purpose is to promote sustainable economic growth by supporting regional technology-based clusters and by serving as a public policy laboratory for technology-related initiatives. MTC administers the Renewable Energy Trust (“RET”) created by the state legislature as part of the Electric Utility Restructuring Act of 1997, whose mission is to help the Commonwealth shift toward greater reliance on renewable energy resources to meet its electricity needs and to spur development of the renewables sector as an important source of economic growth in Massachusetts.

The following document describes the various programs administered by the RET of the MTC. These programs include but are not limited to programs supporting distributed generation ("DG") technologies and applications. All programs include activities related to investment in DG technologies in the state, with the expected outcome of 1100 DG systems to be financed through all MTC programs.

Premium Power/Distributed Generation
The principal aim of the Premium Power/Distributed Generation Program is to promote the use of distributed renewable energy generation technologies in Massachusetts. The initial focus of this $16 million program is on applications that require high reliability and/or power quality, such as is provided by fuel cell-based systems (“premium power” systems). Programmatic activities, such as project financing, technical assistance, and awareness-building, are designed to support development of distributed power generation projects in the Commonwealth.

The initial programmatic efforts began with the issuance of two formal solicitations to explore and promote the use of fuel cells to provide highly reliable power. The first solicitation enables companies, not-for-profit organizations, quasi-public corporations and government agencies to examine the feasibility of using fuel cells in premium power applications. Eligible project activities include assessing current power quality, identifying potential losses resulting from power disruptions, defining power requirements, preparing conceptual designs, analyzing the financial feasibility of alternative systems, and developing bid documents. The intention of the solicitation is to prepare power-purchasers for an investment decision for a distributed power generation system. Most notable among the grantees is the joint partnership of Harvard Medical

School and Merck & Co., Inc., which is using RET grant funds for financial analysis of a 1.2MW distributed generation system in the Longwood Medical and Academic Area of Boston.

The second solicitation makes funds available to help organizations defray the cost of installing fuel cells in stationary, high quality power systems. In this case, the fuel cell-based premium power system must be designed to ensure higher availability than afforded by the local utility. The proposed system can employ commercially available or prototype fuel cells. Through this installation solicitation, MTC has assisted the Nuvera Fuel Cells, Inc. in testing advanced fuel cell power systems. These distributed generation systems provided high quality power at one of Verizon's metro-Boston telecommunications network hub. In addition, MTC has contributed a grant for the installation of DG power system employing a molten carbonate fuel cell at the US Coast Guard Air Station on Cape Cod to aid emergency search and rescue operations on the northeastern seaboard.

Outside of the activities related to the aforesaid public solicitations, the Premium Power/Distributed Generation Program has been very active in analysis of the regulatory and business practice impediments facing distributed generation in the Commonwealth. Most notable of these efforts is the recent issuance of a Request for Information ("RFI") to understand and explore the challenges and potential benefits of using DG – particularly distributed renewable energy resources – to address issues of transmission constraints and distribution system reliability in Massachusetts. The responses to this RFI are summarized in a July 10, 2002 memorandum prepared by the MTC. (Please see Appendix B and C for the RFI and the Responses to the RFI.)

The Green Buildings Program

The Green Buildings Program has allocated approximately $30 million in the form of grants to support "green" buildings in Massachusetts: these grants provide approximately $14 million for the Massachusetts Green Schools Initiative and roughly $16 million for the Massachusetts Green Buildings Initiative. The goal of the Green Buildings Program is to stimulate increased construction of green buildings (ones that incorporate renewable energy technologies, environmental quality, and efficient resource use) in general, and the use of renewable energy technologies in particular in order to increase knowledge about the benefits of green buildings and renewable energy technology among building professionals and the general public. An expected outcome of the program is expected to exceed 5 MW of distributed resource capacity.

The Green Schools Initiative, a collaboration between MTC and the Massachusetts Department of Education, is representative of MTC's comprehensive approach to fostering a sustainable, competitive marketplace for renewable energy in Massachusetts. The Initiative is designed to provide school districts in the Commonwealth with the information and resources necessary to enable the incorporation of renewable energy technologies, environmental quality, and efficient resource use into the planning, design and construction of school building projects. Over $4 million in design, construction and feasibility study grants have been awarded to date.

Nine school districts (Beverly, Brockton, Falmouth, Gill-Montague, Newton, Salem, Somerville, Waltham, and Williamstown) have received design and construction grants to incorporate solar photovoltaic arrays, wind turbines, fuel cells, a variety of energy-efficiency features and related educational program elements into their new school construction or renovation projects. Early next year, the program will seek to award 11 additional design and construction grants to school districts for similar DG installation activities.

Eligible school districts may apply now for $20,000 grants to be used to study the feasibility of various renewable energy technologies, energy-efficiency measures and other high performance design features. Twenty-one feasibility study grants have been awarded to communities all around the Commonwealth. Priority uses for these grants as identified by the grant recipients include the study of wind power, solar power, fuel cells, as well as other areas of energy efficiency and high performance design inquiry and analysis.

The Green Buildings Initiative accepts applications for virtually any type of building from public and private owners and developers interested in integrating high-performance design, energy efficiency and renewable energy technologies into the building project. As with the Green Schools Initiative, green building projects must be located within the service territory of an investor-owned electric distribution company, the project must apply for all available assistance from any utility-sponsored energy efficiency programs, and the building's systems must be commissioned. The end result of the effort will be approximately 50 examples of green buildings using renewable resources for its energy needs located throughout the Commonwealth of Massachusetts, each serving as a local example and model for others. Each serving also as the basis of an intensive case study describing lessons learned and assessing costs and benefits in an effort to shed more light on the key issues of life-cycle cost/benefits and return on investment.

At this time, MTC, through the efforts of the Green Building Initiative, has made grant awards for the first two rounds of the Early Stage Feasibility Study Assistance Grant Opportunity, and the first round of the Design and Construction Assistance Grant Opportunity. The seventeen recipients of feasibility study assistance (up to $20,000 to study technical and financial feasibility of including an eligible renewable energy technology in their projects) include: The Massachusetts Innovation Center (Fitchburg), Cape Cod Community College (Barnstable), Massachusetts Division of Fisheries and Wildlife (Westborough), Lawrence Community Works (Lawrence), MassDevelopment Jones Block Building (Adams), Nature's Classroom (Adams), National Marine Life Center (Wareham/Buzzards Bay), YWCA Boston (Copley Square area). Through a planned future solicitation, MTC expects these grantees to return as applicants for design and construction assistance, to install distributed renewable energy resources in their projects.

Seven owners/developers have been awarded design and construction grants of up to $500,000 a piece to include eligible renewable energy technologies in their construction projects. These grantees are: Genzyme Corporation World Headquarters (Cambridge), City of Cambridge City Hall Annex, Artists for Humanity (Boston), The Trustees of Reservations Doyle Conservation

Center (Leominster), Tufts University Solar Residence Hall (Medford), Woods Hole Research Center Gilman Ordway Campus (Falmouth/Village of Woods Hole), The MATCH ("Media and Technology Charter High") School Foundation (Allston section of Boston). Examples of the distributed renewable energy resources planned as part of these construction projects include roof-mount photovoltaics and building-integrated photovoltaics comprising approximately 250 kilowatts of installed capacity. On-site wind generation and fuel cells are likely to be installed by grantees under forthcoming rounds of the Green Buildings Initiative.

The Green Power Program

The Green Power Program addresses development of new electric generation projects that produce power from renewable energy resources such as wind, biomass, landfill gas and photovoltaic technology for delivery into to the New England distribution grid. The RET has provided financial support for predevelopment activities associated with six potential green power projects which if developed will add more than 50 MW of generation to the New England grid.

Another programmatic activity is the Solar to Market Initiative, a $10 million commitment designed both to encourage greater use of photovoltaic ("PV") systems in Massachusetts and to promote the development of the Commonwealth's PV industry. To assist the industry, the RET provided financial support for establishing the Solar Energy Business Association of New England ("SEBANE"). SEBANE supports the development of PV-powered energy systems through regulatory policy advocacy, public awareness, and legal efforts to enable solar resources to compete fairly in the power market. SEBANE provides PV businesses with a cohesive voice in breaking down the barriers -- including high capital costs and regulatory constraints – that have hindered the full realization of solar technology's potential in this region.

Most recently, MTC released competitive solicitations seeking participation in the Solar to Market Initiative Clustered PV Installations Program, which invites grant proposals, on a competitive basis, for up to $525,000 per project for turnkey development of at least 50 kilowatts of installed PV systems in a clearly defined geographic cluster in areas of Massachusetts served by investor-owned electric distribution utilities. MTC expects to award at least four grants through this program. In the Fall '02, MTC, through its Open PV Installations Program will release a solicitation seeking proposals for financial subsidies for a range of PV installations, with set asides for new construction, existing residential buildings, and existing commercial/industrial/institutional buildings.

APPENDIX B

Massachusetts Technology Collaborative
Renewable Energy Trust

Request for Information ("RFI") Regarding the
Use of Distributed Renewable Energy Generation to
Reduce Problems Associated with
Transmission and Distribution System Constraints
in Massachusetts (Issued May 2, 2002)

Massachusetts TECHNOLOGY Collaborative

RENEWABLE ENERGY TRUST

Request for Information
Regarding the Use of Distributed Renewable Energy Generation
to Reduce Problems Associated with Transmission and Distribution
System Constraints in Massachusetts

May 2, 2002

I. Summary

The Massachusetts Renewable Energy Trust (the "Trust") has released this Request for Information ("RFI") in an effort to understand and explore both the challenges and potential benefits of using distributed generation ("DG") to address issues of transmission and distribution system constraints in Massachusetts. The Trust seeks sufficient information to understand and define the following:

1. The nature of existing and foreseeable problems in constrained areas (congested areas) within Massachusetts and the potential impacts of such constraints on Massachusetts ratepayers;
2. The role and potential impact of DG (especially distributed renewable energy resources) as a component of a comprehensive solution in addressing these problems; and
3. The potential role of the Trust as one of several stakeholders seeking to develop solutions to address these problems.

The Trust seeks information from any and all interested parties in the form of written responses to the questions described in this RFI. Responses are requested on or before <u>June 7, 2002</u>. As a result of this RFI, the Trust hopes to gain an understanding and promote constructive discussion of the above issues. Depending on the lessons learned from the RFI, the Trust may target up to $10,000,000 to support the deployment of distributed renewable resources as part of an effort to address transmission and distribution system constraints in Massachusetts.

II. Background on Trust

The Massachusetts Technology Collaborative (MTC) is charged with the responsibility for administering the Renewable Energy Trust Fund. Created as an integral part of the Restructuring Act of 1997, the Trust's objectives are:

1. To shift energy consumption in Massachusetts from conventional sources to renewable sources;
2. To increase the capacity of installed renewable energy generation in Massachusetts;
3. To grow the renewable energy sector in Massachusetts; and
4. To increase economic activity related to renewable energy in Massachusetts

More information about the Trust and its programs can be found at http://www.mtpc.org/massrenew.

III. Purpose of RFI

One objective of the Trust is to increase the amount of renewable energy generated in Massachusetts. The Trust seeks to achieve this objective in a manner which offers the maximum amount of public benefits. As such, the Trust is interested in understanding any opportunities where issues of constraints within the transmission and distribution systems may present for the use of renewable energy technologies.

The Trust is seeking to understand the effects of constraints within the transmission system (i.e., the network of high-voltage lines that move electricity across relatively long distances) on Massachusetts' electricity consumers. This issue is of particular interest in light of the recent proposal by the Independent System Operator of New England (ISO-NE) to introduce a location-based marginal pricing system designed to reflect the costs of running higher-priced generators within transmission-constrained areas.

In addition, the Trust is seeking to understand the effects of constraints within the distribution system (i.e., the network of lower voltage lines that are installed and maintained by the regulated distribution companies) on Massachusetts' electricity consumers. *Note: While the Trust is interested in issues relating to both the transmission and distribution systems, respondents to the RFI may address either or both as they see fit.*

The Trust is also interested in furthering the public discussion already underway on these topics and in building consensus among various interested parties.

As a result of the above concerns, the Trust has issued this RFI. Through this RFI the Trust seeks sufficient information to understand and define the following:

1. The nature of existing and foreseeable problems in constrained areas (congested areas) within Massachusetts and the potential impacts of such constraints on Massachusetts ratepayers;
2. The role and potential impact of DG (especially distributed renewable energy resources) as a component of a comprehensive solution in addressing these problems; and
3. The potential role of the Trust as one of several stakeholders seeking to develop solutions to address these problems.

The Trust is soliciting this information in the form of responses to specific questions listed below. Responses are sought from any and all interested parties, including but not limited to Members of the General Court, Massachusetts municipalities, the Massachusetts Office of the Attorney General, the Massachusetts Department of Telecommunications and Energy, the Division of Energy Resources, the Massachusetts Executive Office of Environmental Affairs, investor-owned electric and natural gas distribution companies in Massachusetts, the Independent System Operator – New England (ISO-NE), NEPOOL participants, fuel cell manufacturers, members of the energy industry applying technologies pertinent to this topic, the United States Department of Energy, the United States Environmental Protection Agency, SEBANE, the Union of Concerned Scientists, the Conservation Law Foundation, the Massachusetts Public Interest

Research Group, the Mass Energy Consumers Alliance, and other organizations or individuals representing Massachusetts ratepayers. In addition, responses are sought from individual citizens, businesses, and organizations interested in the issues included in the scope of this RFI.

As a result of the RFI, the Trust hopes to gain clarity on interests and viewpoints of various stakeholders, and to help build consensus about the nature of system constraint problems, the role and potential impact of distributed renewable energy generation as part of a solution, and the role of the Trust in future activities.

Ultimately, if there is consensus support for installing distributed renewables in Massachusetts, the Trust may allocate up to $10,000,000 to support the deployment of clean, distributed resources in ways that would diversify the supply of energy resources to Massachusetts ratepayers.

IV. Requested Information

The Trusts seeks information in response to the following questions.
Respondents are encouraged to answer only those questions that are of primary interest to them.

I. Use of DG to Address Transmission and/or Distribution Constraints

A. What specific issues related to transmission and/or distribution system constraints should be of primary concern?
B. To what extent does DG have a role in addressing those issues?
C. Other than DG, what types of resources and/or energy management techniques can be used to address transmission and/or distribution constraints?
D. What will be the impact of location-based marginal pricing or zonal pricing on the viability of DG use to address transmission and/or distribution constraints?
E. What are the primary benefits of using DG to address transmission and/or distribution constraints?
F. What additional (secondary) public benefits might be derived from DG installation projects?

II. Challenges of DG Use

A. What are the current economic, technical, and regulatory challenges which may prevent widespread application of DG in Massachusetts?
B. What additional barriers may exist in the foreseeable future that are not yet identified?

III. Amount of DG to Install

A. How much DG capacity (total MW) would need to be installed to adequately address transmission and/or distribution system constraints in Massachusetts?
B. What is the minimum capacity of DG which would need to be installed to have any significant impact? What is the incremental impact when each additional MW of DG is added? How could the incremental benefits of installed DG capacity be measured?
C. What is the feasible limit (technological, environmental, regulatory, etc.) of the amount of DG which could be installed?

IV. Locations for DG Installations

A. Where are the load pockets in Massachusetts that would best be served by DG?
B. What factors would make a particular site a good candidate to realize the maximum amount of value from a DG installation? What are examples of specific high-value sites?
C. To what extent are customers willing to site the various DG technologies on their property? What are the factors that motivate such willingness?
D. Are there existing permitting concerns for siting DG in certain areas?

V. Investor-Owned Utilities ("IOUs") and DG

A. Should IOUs own DG? If so, is legislation required to satisfy this goal?
B. Is DG something that should be incorporated into IOU integrated resource planning, and, if so, how?

VI. How to Start

A. What studies are needed to decide whether DG technologies are a suitable solution to transmission and/or distribution system constraint problems?
B. Would a pilot program be an appropriate starting point to address transmission and/or distribution constraints before installing DG on a wide spread basis?
C. How could installation projects best be financed?

VII. Use of Renewable Energy Technologies

A. To what extent are the eligible renewable energy technologies (as defined by the Trust below) a viable option for installations to address transmission and/or distribution constraints (especially given the intermittent nature of some renewable energy technologies)?
B. How can eligible renewable technologies best be used to address transmission and/or distribution constraints (i.e., in combination with what other non-renewable resources and/or additional energy management techniques)?

VIII. Further Information

A. Is there any additional information that should be considered as part of a discussion of the use of DG to address transmission and/or distribution constraints?
B. Are you interested in serving on a working group to further study this issue?

V. Procedural Information

This RFI is solely meant to solicit information and to identify infrastructure services as described. This RFI is NOT a request for bids, an offer, or solicitation. This RFI does not obligate or bind MTC to procure any goods or services as a consequence. Responses to this RFI do not constitute bids or proposals and are not legally binding on the responding party. Respondents may not charge MTC or the Commonwealth of Massachusetts for any costs associated with the preparation of responses to this RFI. MTC will immediately discard, without review, any bids received.

VI. Response Format and Deadline
Interested parties who wish to submit a response to the questions as stated above to this RFI must do so on or before 3:00 PM, June 7, 2002.

Respondents are encouraged to answer only those questions that are of primary interest to them.

Responses should be submitted via electronically in MS Word 6.0 or PDF format to MTC at the following email address: rfi.dg@mtpc.org

VII. Meeting
MTC has scheduled an informal meeting for interested parties to discuss the nature of system constraint problems and the role and impact of distributed renewable energy generation as part of a solution, as well as current industry standards, practices, or any other information deemed relevant to identifying the role of the Trust in future activities. If you plan on attending this meeting, please inform Anjanette Alpher by June 26, 2002, to ensure that adequate room arrangements can be made.
Date/Time: July 10, 2002 3:00pm
Location: MTC, 75 North Drive, Westborough, MA
Contact : Anjanette Alpher (508-870-0312 x1-238; email: alpher@mtpc.org)

VIII. Definitions

A. Definition of Eligible Renewable Energy Technologies
As defined in MGL ch.40J §4E(f)(1):

> For the purposes of expenditures from the fund, renewable energy technologies eligible for assistance shall include the following: solar photovoltaic and solar thermal electric energy; wind energy; ocean thermal, wave, or tidal energy; fuel cells; landfill gas; waste-to-energy which is a component of conventional municipal solid waste plant technology in commercial use; naturally flowing water and hydroelectric; low emission, advanced biomass power conversion technologies, such as gasification using such biomass fuels as wood, agricultural, or food wastes, energy crops, biogas, biodiesel, or organic refuse-derived fuel; and storage and conversion technologies connected to qualifying generation projects; provided, however, that expenditures related to waste-to-energy projects or facilities shall be limited to funds segregated pursuant to paragraph (2) of ch.40J §4E(f). Such funds may also be used for appropriate joint energy efficiency and renewable projects, as well as for investment by distribution companies in renewables and distributed generation opportunities….

B. The Trust's Definition of Distributed Generation
Differing fundamentally from the traditional model of large, central generation (> 20MW) and delivery, the Trust defines distributed generation (DG) as energy generated from integrated use of small, modular electric generation devices close to the point of consumption, insofar as it can be located near end-users within an industrial area, inside a building, or in a community. The downstream location of DG in the power-distribution network provides benefits to both customers and electric-distribution system. The smaller size and modularity of DG support a

potentially broad range of customer- and grid-sited applications where central plants and large transmission networks would prove impractical.

C. Definition of Distributed Renewable Energy Generation

For the purposes of the Trust, distributed renewable energy generation is energy generated by eligible renewable energy technologies (as defined above) in a distributed generation application. Of the above-listed eligible technologies, waste-to-energy would not be considered distributed renewable energy generation because projects or facilities using waste-to-energy technologies would be defined as central power generation, and because the legislative mandate regarding segregation and use of funds, as delineated in M.G.L. ch.40J §4E(f)(2) would prohibit funding. Storage and conversion technologies connected to qualifying distributed renewable energy generation projects may include flywheels, advanced batteries, hydrogen production and distribution systems, power electronics, and hybrid generation system components.

It is anticipated that fuel cells and photovoltaic resources are the best suited of the eligible technologies for the type of distributed generation applications being discussed here.

IX. Notice of Public Disclosure

As a public entity, MTC is subject to the Massachusetts Public Records Law. Documents and other materials made or received by its employees are subject to public disclosure unless they are specifically exempted. Careful consideration should be given before confidential information is submitted to MTC. Respondents should submit only the information that is essential to support their responses. Respondents who want to submit proprietary information must comply with the following procedures *prior* to submitting the information. Failure to follow the procedures may result in the inability to protect the confidentiality of the information.

Respondents seeking to have MTC assert the proprietary exemption must file a written request prior to submitting the information, identifying the record constituting proprietary information, and the reasons why disclosure of such record would cause substantial injury. The request shall be sent to the MTC General Counsel, Philip F. Holahan, at 75 North Drive, Westborough, Massachusetts 01581. No electronic or facsimile submissions will be accepted.

All materials submitted become the property of MTC and will not be returned.

X. Questions

For more information or answers to questions about this RFI, please contact Raphael Herz, Premium Power Program Director via email at rfi.dg@mtpc.org.

APPENDIX C

Massachusetts Technology Collaborative
Renewable Energy Trust

Summary of Comments to the May 2, 2002 RFI
(Dated July 10, 2002)

SUMMARY OF RESPONSES TO A REQUEST FOR INFORMATION REGARDING DISTRIBUTED GENERATION

Prepared By:
Lexecon Inc.

Prepared For:
Massachusetts Technology Collaborative ("MTC")

Issued On:
July 10, 2002

I. Background and Summary

On May 2, 2002, the Renewable Energy Trust ("Trust")[3] issued a Request for Information ("RFI") in an effort to understand and explore the challenges and potential benefits of using distributed generation ("DG") – particularly distributed renewable energy resources – to address issues of transmission constraints and distribution system reliability in Massachusetts.[4] The Trust received about two dozen responses to the RFI in June '02, including comments from government agencies, distribution utilities, DG vendors, and industry and public interest groups. This brief report highlights some of the major issues related to DG viability, barriers and implementation raised by commenting parties in response to the RFI.

The purpose of this brief summary is to document major issues associated with DG discussed in the RFI comments while providing a foundation from which future investigations into this matter can be pursued. As part of the RFI process, the Trust has scheduled a public meeting for Wednesday, July 10, 2002 to further discuss the potential role and impact of renewable DG on electricity system constraints in Massachusetts. With the addition of information gained from this public meeting, the Trust anticipates issuing a final report summarizing its findings. The Trust expects this draft report and subsequent Trust activities to provide clarity on interests and

[3] Massachusetts Technology Collaborative, administrator of the state's $150 million Renewable Energy Trust, is helping to build a sustainable, competitive market for renewable energy in the Commonwealth through its legislative mandate to increase the supply of and demand for green power while expanding economic activity in the state's renewable energy industry. For more on MTC, please visit www.masstech.org.
[4] Massachusetts Technology Collaborative, *Request for Information Regarding the Use of Distributed Renewable Energy Generation to Reduce Problems Associated with Transmission and Distribution System Constraints in Massachusetts*, May 2, 2002.

viewpoints of various stakeholders, as well as to help build consensus about the role of and potential impact of renewable DG on mitigating system constraint problems.

The Trust has organized this summary to (1) identify the rationale for, and benefits of, expanded use of DG identified by commenters; (2) highlight the technical issues for DG noted in comments; and (3) discuss commenters' perceptions of the major economic, institutional, and regulatory barriers to the expanded application of DG technologies. Finally, the conclusion briefly pulls together the themes raised by commenters and their implications for the future deployment of DG in Massachusetts.

Commenting parties identified a wide range of potential benefits of DG, including enhanced power system reliability and quality, improved regional market and customer economics, other social and economic benefits associated with potential reductions in human health and environmental impacts of energy production and delivery, local business opportunities, fuel and capacity diversity, and security. It should be noted, however, that many commenters suggested that DG applications are not economically attractive on the basis of electricity sales alone and therefore require additional site-specific benefits such as power quality redundancy and combined heat and power ("CHP") in order to enhance their economic viability. Commenters also identified additional potential problems, particularly if DG expands in a manner that ignores interconnection reliability and power quality requirements, fails to recognize the unique operational characteristics of certain DG technology options, or ignores the relatively severe environmental impacts associated with certain DG technology options. In short, it is clear that while DG can provide substantial benefits to society, it will not do so without careful consideration of various technical, economic, institutional and regulatory issues.

The comments received strongly suggest that DG economics and viability are hindered by a number of technical, economic, institutional and regulatory barriers. While the technical barriers per se are capable of being largely overcome, institutional and regulatory barriers pose significant deterrents to DG expansion. These barriers are built into distribution company interconnection standards, tariffs, revenue recovery, system information disclosure, and long-term planning mechanisms. Additional barriers appear to exist in regional market rules and potentially in the field of environmental permitting. While some of these barriers may limit or prevent the development of DG technologies in certain locations, many of the barriers manifest themselves as additional economic hurdles to the development of cost-effective and socially beneficial DG applications.

Recognizing DG's potential benefits and the need to address barriers, a number of industry and regulatory efforts are underway to reduce or eliminate the financial and regulatory deterrents to DG. At the national level, the Institute of Electrical and Electronics Engineers, Inc. ("IEEE") has undertaken an effort to develop uniform interconnections standards. At the state level, the Massachusetts Department of

Telecommunications and Energy initiated a proceeding[5] on June 13, 2002 to review distributed generation issues. The existence of these and other efforts are evidence of a resurgence of interest in the future development of DG in Massachusetts.

II. Benefits of Distributed Generation

Reliability and Power Quality Benefits

Commenting parties identified a number of aspects of power system reliability and power quality potentially bolstered by a wider application of DG technologies. Commenters also noted that DG was one of a number of types of resources or energy management techniques that can be used to address transmission and/or distribution constraints. Other options include energy efficiency and load response, as well as traditional transmission and distribution infrastructure investments.

The strength of DG technologies in power supply quality and reliability relies upon the flexible, dispersed nature of DG installations, the ability to locate these facilities close to the load, and their relatively small size. Additional power quality benefits are associated with the ability of some DG technologies to come on-line in a relatively short time frame. Some commenters suggested that whether DG could provide some of these benefits (such as voltage stabilization and addressing power factor concerns) would depend strongly on the DG technology type, design, and its ability to interconnect to the grid at the appropriate location and time. Specific reliability and power quality benefits identified by commenters include the following:

- DG resources can add capacity, reserves, and ancillary services to the system.
- DG can assist in local voltage stabilization, particularly in areas where it may be politically or technically infeasible to add larger-scale generation.
- DG can reduce local line loading and improve circuit reliability.
- Well-designed DG installations can help address power factor concerns.
- DG can be used to respond to sudden system contingencies.
- Certain DG technologies can help with system restoration.
- DG provides an "option value" (tied to size and mobility – addressing local system problems with a localized and appropriately-scaled response).

Economic Benefits

Many commenting parties pointed out ways in which wider dispersion of DG applications would generate direct economic benefits to customers. Some benefits

[5] Massachusetts Department of Telecommunications and Energy, *Investigation by the Department of Telecommunications and Energy on its own Motion into Distributed Generation D.T.E. 02-38*, June 13, 2002 (www.mass.gov/dpu).

would accrue directly to a customer choosing to install DG; others would accrue to all customers whether the DG technology is installed by another customer in the local area or region, or used by a distribution company as a least-cost solution to transmission and distribution system maintenance, repair, or upgrade. Specific economic benefits identified by commenters include the following:

- Additional DG installations could reduce wholesale prices (and thus retail prices to customers) by providing additional competitive supply (or demand response if, in effect, the generation is used to reduce the load - rather than meet it - from the perspective of market transactions).
- With the advent of location-based marginal pricing ("LBMP"), the impact of DG on wholesale power costs would be enhanced in congested zones (e.g., Boston and Northeast Massachusetts).[6]
- DG can reduce costs associated with line losses.
- DG can play a risk management role.
- Customer DG installations can be a source of supplemental income or reduced costs associated with enhanced CHP applicability (since DG will typically be located closer to end-use electric customers).
- DG can be used as a tool to avoid or defer investments in transmission and distribution repair and infrastructure.

Additional Benefits

Finally, commenting parties highlighted a number of additional benefits associated with the growth of DG in the region. While these additional benefits are real, they are spread across a wide range of recipients and are difficult to quantify or monetize in a way that allows for a comprehensive cost/benefit analysis. Specific indirect and other benefits identified by commenters include the following:

- Certain DG technologies (e.g., renewable-fueled DG, fuel cells, and to some extent gas-fired microturbines) generate electricity with essentially zero emissions, or at emission rates substantially below the average or marginal emission rates of generation in the region. Operation of these technologies would result in a significant public health and environmental benefits.
- The potential environmental benefits of these DG technologies may be strongly amplified by the fact that DG can and often will be located in relatively congested urban areas, and operated with greatest frequency during high-load conditions typical of hot summer days.[7]

[6] Under LBMP, zones that are constrained will see higher energy prices than unconstrained zones as costs of congestion are allocated to zones experiencing congestion rather than socialized to all customers in the region. The installation of DG in congested zones can therefore have a bigger impact in reducing costs and prices because the costs/prices will be higher in these zones.

[7] Reducing emissions that lead to ground-level ozone and particulates in these locations and under these conditions carries a far higher potential benefit than it would in rural areas or under average regional ambient air quality conditions.

- DG can provide fuel diversity and reduced dependence on imported fossil fuels.
- DG can reduce vulnerability to security issues through the greater number, geographic dispersion, and smaller size of generation resources in the state.
- DG can generate economic benefits through the development of local business opportunities to design, build, maintain and repair DG installations.

III. Technical Issues Associated With Distributed Generation

Commenting parties highlighted a number of technical issues that could arise from the introduction of significant amounts of DG into the current power system, particularly if DG expands in a manner that ignores interconnection, reliability and power quality requirements, fails to recognize the unique operational characteristics of some DG technology options, or ignores the relatively severe environmental impacts associated with other DG technology options. In fact, some commenters suggested that, rather than providing power system quality and reliability benefits, DG had the potential to exacerbate these issues if its integration with the electrical grid is poorly conceived or executed. Specific technical issues raised by commenters include the following:

- Increasing the number and dispersion of power sources will increase the number of "failure points," with an increase in the potential number of disturbances on the system.
- Increasing power supplies in a local area, particularly areas with sensitive electrical equipment, could decrease power quality in that area by increasing fluctuations in voltage and reactive power (e.g., where local DG units are powering up or tripping off the system). At a minimum, this situation might require more proactive regulation of voltage and reactive power, using advanced distribution system technologies.
- Installation of some DG technologies may require accompanying use of other technologies, such as energy storage, to mitigate potential negative power quality effects.

In addition to discussing the technical barriers associated with DG, some respondents noted features of DG technologies that could complicate market interactions or at least reduce the value of such resources for power supply reliability and quality. Some examples of these comments include the following:

- The output of some DG technologies (such as wind and solar applications) is intermittent, and dependent upon climate conditions. That is, these DG applications are basically non-dispatchable, and thus their value for system security purposes is limited.

- Many DG applications are fairly small in size, complicating or limiting their interaction with the system operator from the perspective of real-time operations and/or financial settlement purposes.
- In order to take advantages of market price fluctuations, customers with DG facilities would need to install advanced metering.

Finally, a number of commenters pointed out that the lowest priced and most commercially advanced DG technologies today (e.g., diesel-fueled DG) are in fact the worst technologies from the standpoint of delivering environmental or fuel diversity benefits. Expanded operation of existing and/or new diesel generators could result in increased emissions and environmental impacts if other resources that are characterized by significantly lower emission rates and other environmental impacts are dispatched or operated less often.

IV. Economic, Institutional and Regulatory Barriers to Distributed Generation Expansion

Economic Barriers

The Trust received numerous comments discussing the barriers to additional expansion of DG in the regional electric system. Barriers presented by parties ranged from straight project economic considerations that may be overcome only through additional development and marketing efforts, to institutional and regulatory barriers that can be addressed through careful attention of the appropriate industry and/or regulatory bodies. It is the sense of many respondents, however, that the primary impediment to DG expansion is the direct economic barrier to installation of DG by end-use customers. Examples of comments along these lines include the following:

- DG is simply more expensive relative to other sources of electricity.
- Social and environmental benefits are not a factor as they are external to the individual customer cost/benefit analysis.
- In order to capitalize on additional site-specific benefits of DG such as power quality redundancy and combined heat and power ("CHP") applications, customers would be required to invest in additional system configurations and processes.
- Even where there are customers for whom DG would be cost-effective, customers are resistant to expend capital or pursue financing for DG design and installation, as it is not a part of their core business activity.
- There are financing impediments to DG. For example, many DG technologies have cost profiles such that installation would cost too much for out-of-pocket payment, but these costs do not rise to a level large enough for project financing.

Institutional Barriers

While these are examples of direct cost factors, many commenters suggested that the majority of costs preventing expansion of DG come in the form of indirect costs associated with overcoming significant institutional and regulatory barriers to building, connecting, and profiting from DG applications. Examples of comments on institutional barriers include the following:

- The most significant institutional barrier is the fundamental disincentive to distribution and transmission companies due to the fact that expansion of customer generation represents a direct erosion of distribution company revenues, where revenue collection is a function of sales volume (as is the case with all Massachusetts distribution utilities).
- This fundamental revenue erosion disincentive means that it runs counter to distribution utilities' business interests to address barriers to development of DG associated with distribution utility tariff design and interconnection policies.
- Utility tariffs for standby and backup service present a significant barrier to DG installation.
- Distribution companies lack simple, consistent interconnection policies for DG technologies.
- Distribution companies should make public technical information on the distribution system that would help prospective DG developers take advantage of higher-value locations for DG under LBMP.
- Customers will not embrace DG until they see accurate electricity price signals.
- Many customers that could benefit from DG are simply not aware of its potential benefits and savings.

Regulatory Barriers

Examples of comments on regulatory barriers include the following:

- There is likely to be a valuable role that distribution companies could play in the expansion of DG, yet there is a legal question whether distribution companies in Massachusetts can own DG. Many commenters suggested that DG ownership should be an option for distribution companies, and that any potential legal impediment to this should be removed. Others suggested that distribution company ownership could harm the development of a competitive market. Finally, others suggested that DG ownership is not necessary for distribution companies to play a useful role in expanding DG applications.
- Currently in Massachusetts, distribution companies are not required in planning for long-term needs to comprehensively evaluate a range of options, including DG, to identify potentially least-cost solutions to such long-term transmission and distribution system needs.
- Massachusetts non-attainment status under the Clean Air Act requires some fairly prescriptive permitting reviews for most new DG facilities. Some commenters

suggested that emission permitting could be made significantly easier, particularly for DG technologies with zero or very low emission rates.

V. Conclusion

Commenting parties generally agreed that DG offers the potential to address issues related to transmission constraints and distribution system reliability in Massachusetts, but that it faces a variety of technical, economic, institutional and regulatory barriers that limit its ability to fulfill this promise. Many, if not all, of the technical barriers translate largely into economic barriers as they can be overcome at some cost. A technical issue that remains is the possible impact of significant amounts of DG on system stability and reliability. The economics of DG continue to be such that the benefits (e.g., environmental, system security, wholesale price impacts) are not easily captured by those making the investment (either customer or distribution company). For customers, the economic benefits of DG generally must be accompanied by other benefits (e.g., power quality, CHP) for the investment to be attractive.

Institutional and regulatory barriers were cited by respondents as major deterrents to expansion of DG applications. Because of the way that costs are recovered and rates are designed, distribution companies have a fundamental disincentive to invest in DG themselves or to facilitate investment by customers. Additional institutional and regulatory barriers include a lack of information on the benefits of DG and failure to systematically include DG and other non-traditional options in transmission and distribution system planning processes. Finally, environmental permitting policy and practices may pose a barrier to DG technologies, even those with zero or very low emission rates. Commenting parties as a whole expressed the view that continued efforts to address barriers to the expanded application of DG technologies would be worthwhile.

The Trust plans to use the information gained through this RFI to help further understand and explore the challenges and potential benefits of using DG to address issues of transmission constraints and distribution system reliability in Massachusetts. This draft report, in conjunction with information gained through any future public meetings and inquires will also help form the foundation for a final report summarizing the Trust's findings and help define what role the Trust may play in future activities regarding transmission constraints and distribution system reliability in Massachusetts.